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THESIS

THE S-3 VIKING WEAPON SYSTEM IMPROVEMENT PROGRAM: FINANCIAL MANAGEMENT IMPLICATIONS

by

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December 1990

Thesis Advisor: Joseph G. San Miguel

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In response to recent significant improvements in Soviet Submarine Technologies the Navy developed the Weapon System Improvement Program for the S-3A Viking. This program is an example of the dynamic nature of the environment within which the program manager operates. It provides the program manager with little control over certain events and the effects they have on their programs. An effective program manager will realize these limitations exist and attempt to strategically and flexibly manage the resources available to him as effectively and efficiently as his/her political environment will allow. However, this sometimes happens at the expense of contractor inefficiencies and at a higher cost to the Government. In the DOD/DON world of scarce resources a thorough analysis of the competitive environment may provide useful insight into the S-3 Program Office and their efforts to complete the S-3 WSIP.

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The S-3 Viking Weapon System Improvement Program:
Financial Management Implications

by

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ABSTRACT

In response to recent significant improvements in Soviet Submarine Technologies the Navy developed the Weapon System Improvement Program for the S-3A Viking. This program is an example of the dynamic nature of the environment within which the program manager operates. It provides the program manager with little control over certain events and the effects they have on their programs. An effective program manager will realize these limitations exist and attempt to strategically and flexibly manage the resources available to him as effectively and efficiently as his/her political environment will allow. However, this sometime happens at the expense of contractor inefficiencies and at a higher cost to the Government. In the DOD/DON world of scarce resources a thorough analysis of the competitive environment may provide useful insight into the S-3 Program Office and their efforts to complete the S-3 WSIP.

TABLE OF CONTENTS

I. INTRODUCTION ---------------------------------- 1

A. NATURE OF THE PROBLEM -------------------- 1

B. THESIS OBJECTIVES ------------------------ 2

C. RESEARCH QUESTIONS ----------------------- 3

D. SCOPE, LIMITATIONS AND ASSUMPTIONS -------- 4

E. METHODOLOGY ------------------------------ 5

F. ORGANIZATION OF STUDY -------------------- 5

II. BACKGROUND ------------------------------------ 7

A. OPERATIONAL BACKGROUND OF THE S-3 --------- 7

B. DEVELOPMENTAL BACKGROUND OF THE S-3 ------- 12

C. OPERATIONAL NEED -------------------------- 14

D. OPERATIONAL CONCEPT ----------------------- 15

E. CAPABILITIES REQUIRED --------------------- 16

F. QUANTITY AND COST OBJECTIVES -------------- 18

G. S-3 WEAPON SYSTEM IMPROVEMENT PROGRAM (WSIP) ------------------------------------ 19

H. SYSTEM GROWTH ----------------------------- 21

I. THE WSIP CONTRACTOR ----------------------- 21

J. FINANCIAL CONSTRAINTS --------------------- 22

K. SUMMARY ----------------------------------- 27

III. RESEARCH APPROACH --------------------------- 29

A. INTRODUCTION ------------------------------ 29

B. FRAMEWORK FOR ANALYSIS -------------------- 29

C. DATA COLLECTION ---------------------------- 37

D. SUMMARY ------------------------------------ 39

IV. ANALYSIS AND DISCUSSION OF THE DATA ------------ 40

A. PRESENTATION OF THE WSIP DATA -------------- 40

B. ANALYSIS OF THE WSIP ----------------------- 48

C. RAMIFICATIONS OF THE BUDGET REVIEW ON THE WSIP PRODUCTION --------------------- 57

D. SUMMARY ------------------------------------ 58

V. CONCLUSION AND RECOMMENDATIONS ----------------- 59

A. FINDINGS ----------------------------------- 59

B. RESEARCH AND SUBSIDIARY QUESTIONS ---------- 61

C. RECOMMENDATIONS ---------------------------- 62

D. CONCLUSION --------------------------------- 63

LIST OF REFERENCES ---------------------------------- 64

INITIAL DISTRIBUTION LIST --------------------------- 65

LIST OF TABLES

I.	WSIP PRODUCTION QUANTITIES -------------------	42
II.	PROPOSED WSIP PRODUCTION COSTS FY84 -----------	44
III.	PROPOSED WSIP PRODUCTION COSTS FY87 -----------	45
IV.	PROPOSED WSIP PRODUCTION COSTS FY87 -----------	45
V.	PROPOSED WSIP PRODUCTION COSTS FY90 -----------	46
VI.	PER UNIT COST ESTIMATES FY87 ------------------	47
VII.	WSIP COMPONENTS; "BROKEN OUT" TO GFE AND GFE (COMPETITIVELY SELECTED) ------------------	50
VIII.	WSIP CONTRACTS AWARDED TO LOCKHEED ------------	51
IX.	WSIP PER UNIT COST AS CALCULATED BY LOCKHEED --	51
X.	COMPARISON OF WSIP TOTAL PRODUCTION COSTS -----	55

LIST OF FIGURES

1. S-3 WSIP Program Structure ---------------------- 28

2. Competitive Strategy Model ---------------------- 31

I. INTRODUCTION

A. NATURE OF THE PROBLEM

The S-3A Viking is a multi-engine, carrier-based aircraft that is tasked with the primary mission of anti-submarine warfare. This mission is of critical importance to an aircraft carrier's primary mission of force projection. Unfortunately, technological advances in the area of anti-submarine warfare have lessened the effectiveness of the S-3A's capabilities.

The Department of the Navy has been aware of the need for an improved anti-submarine warfare capability. The CNO stressed the strategic importance of anti-submarine warfare (ASW) as follows;

> ...we must not relax our present strong commitment to the ASW challenge, and we must continue to make good decisions about the kind of ASW forces we want in the future. [Ref. 1]

Adding emphasis to the need for the integration of advanced anti-submarine warfare technologies within the fleet's surface and airborne anti-submarine warfare units were a series of events which occurred in the 1980's. The primary cause for concern, by senior naval officials, was the rapid introduction of several new and advanced soviet submarines. These classes of submarines were and are becoming progressively quieter not only with the introduction of each

new class, but also within the older established classes as they are retrofitted with advanced technology.

Also,

> The 1985 convictions of the so called Walker family spy ring--Department of the Navy civilians found to have sold key submarine technology to soviet agencies--buttressed the assertion that soviets were still actively engaged in espionage. [Ref. 2]

In addition, extensive evidence allowed intelligence sources to conclude that Toshiba and a Norwegian defense contractor, Kongsberg Vaapenfabrik, had sold milling equipment and computer software capable of duplicating the advanced propellers of the U.S. submarines. This event alone is believed to have had the largest impact in reducing the technological advantages of the U.S. Navy.

An advanced anti-submarine warfare capable aircraft was needed to supplant the role of the current S-3A. The Navy set out to accomplish this task in light of these developments. After much debate on possible alternatives the ultimate decision was to use the proven airframe of the S-3A and upgrade the internal avionics to meet the needs of the fleet.

This upgrade of the S-3A was designated the Weapons System Improvement Program (WSIP). After an S-3 aircraft received this modification it would then be designated an S-3B.

B. THESIS OBJECTIVES

The objective of this thesis is to provide an in-depth analysis of the conceptualization, budget, and execution of

the S-3 WSIP. This analysis is intended to determine to what extent the fiscal, political, and operational forces within the Federal Government have affected the financial management of this long term program. In light of this analysis it is hoped that an insight into the environment within which a program manager operates and the responsibilities of the program manager will be obtained. This research will provide evidence on the operating efficiency and effectiveness of a specific DOD weapon system program that resulted from changes in the environment, the program office, and in the contracting process itself.

C. RESEARCH QUESTIONS

The primary research questions to be answered by this thesis is: 1) How do program managers deal with the uncertainty inherent in the budget environment and within the budgetary process? 2) If a budget submission is reduced, what are the short-term and long-term ramifications? 3) What trade-offs between dollars and mission were decided and how did they impact the program completion, schedule, per unit costs and total costs?

Subsidiary questions will discuss: 1) To what extent the S-3 Program Office at NAVAIR is able to control the progress of the WSIP? 2) Are programs more sensitive to budgetary constraints at different points in the acquisition process?

D. SCOPE, LIMITATIONS AND ASSUMPTIONS

The scope of this thesis will be limited to the S-3 WSIP and the efforts of that program office to complete the program. The main focus of the analysis will concentrate on the available financial data of the total costs of the program used by the program office. These data will be used for the analysis because they are the data the program office presented during their periodic milestone reviews. Thus, these reports represent official results of the program.

The analysis will be limited to some extent by the sensitivity of some data. Although the subject matter may not be classified for national security reasons, it may be considered to be procurement sensitive. In regard to the latter, the program office is not obligated to release this information. Every effort will be made to direct the analysis from this type of information.

The assumption underlying this analysis of the WSIP is that the environment within which the program office operates is extremely dynamic. As a result there is little stability in this perpetually evolving political environment. Because of this, the analysis will be presented to achieve a fundamental understanding of the basics and assist in the learning process of future program managers.

E. METHODOLOGY

The method by which the WSIP will be analyzed will be a case study. This method was determined to be the most applicable to and effective analysis of the WSIP. Also, financial data gathered from the S-3 Program Management Office will be analyzed.

The primary source of information to be utilized will be documentation obtained from the S-3 Program Office.

Other methods such as interviews will be used to fill in the gaps of knowledge between documentation and the analysis. The interviews will predominantly assist in determining how the data was developed and used.

Journals will be used to the extent they aid in describing the political environment. In addition, a widely used competitive analysis model will be introduced for examining the WSIP program and its environment from a competitive perspective.

Finally, the researcher's experience will be used to provide a reference to the operational environment within which the aircraft operates.

F. ORGANIZATION OF STUDY

Chapter II provides an in-depth background of the S-3, its various missions within the carrier battle group, the aircraft's struggle within the Department of Defense and the

Department of the Navy and the political issues which have affected the WSIP directly and indirectly.

Chapter III details the research approach that was used to analyze the WSIP. This includes the presentation and discussion of a framework for competitive analysis commonly used in the private sector.

Chapter IV is the analysis of the WSIP and discussion of the implementation, budget, and costs for the S-3 WSIP.

Chapter V contains the conclusion, findings and recommendations.

II. BACKGROUND

A. OPERATIONAL BACKGROUND OF THE S-3

The S-3 Viking is the most versatile and widely used carrier based aircraft in the Navy's inventory. Since its entry into the fleet in 1974, the S-3 has been providing the carrier battle group commanders with the largest variety of missions of any carrier based aircraft. The primary and secondary missions of the S-3 include: anti-submarine warfare (ASW); surface search and coordination (SSC); anti-surface warfare (ASUW); and strike warfare, which includes mine warfare (MW); electronic surveillance measures (ESM); and electronic countermeasures (ECM).

These missions are performed by a four-man crew. This crew is composed of a pilot (who is designated a naval aviator), a copilot/co-tactical coordinator (COTAC) (this seat can be fill by a naval aviator or a naval flight officer), a tactical coordinator (TACCO) (this seat is always filled by a naval flight officer), and a sensor operator (SENSO). The sensor operator is the only enlisted person to fly in a carrier-based jet.

The responsibilities of the flight crew are as follows. The pilot is tasked with piloting and safety of flight. Safety is the foremost consideration job within the aircraft. The COTAC is tasked to back up the pilot, assist in radio

communications, and to help the TACCO. This position can be extremely critical during the attack phase of an ASW mission. The TACCO is responsible for the accomplishment of the mission. The SENSO works with the TACCO to help monitor the computer.

To assist the flight crew, the S-3 has a general purpose digital computer (GPDC). The GPDC enables the flight crew to monitor and interface with over 45 different subsystems within the airframe.

The most notable system which interfaces with the computer is the radar system. This system has three different modes to assist in surface search, weather avoidance, and the identification of small objects. An example of small objects would be periscopes or life rafts.

Another system is the forward looking infrared (FLIR) which is used to visually identify contacts at night. This feature allows the differences in the temperature of objects to be visually displayed on a computer terminal. Currently, fog and precipitation degrade the effectiveness of the FLIR. In order to minimize this shortcoming, the radar can be used to guide the FLIR to the approximate geographical location. Using this method does not preclude the use of the FLIR when precipitation is present.

A third system is the armament control panel (ARMCOS) which controls the release of weapons. Weapons can be carried on wing pylons or within the bomb bays. The bomb bays provide

a covert means of carrying weapons. ARMCOS can be actuated by the TACCO (through the GPDC), the pilot (through the weapons release on the control stick), and the COTAC (through the ARMCOS control panel).

An S-3 is authorized to carry a wide variety of weapons. These weapons include mines, torpedoes, cluster bombs, rockets, flares and general purpose bombs. These weapons can be carried as previously outlined.

The electronic surveillance measures capability of the S-3 is formidable. This ability allows the aircraft to go out and passively search for other search radars. This capability allows the S-3 to alert the carrier to enemy radar transmissions, so that the carrier can avoid being detected.

The primary mission of the S-3 is ASW. The role of the S-3 in the carrier battle group ASW picture is to "sanitize" the areas designated to be the "middle zone." The middle zone extends from 75 miles to 200 miles.

Helicopters cover the inner zone, which extends from the carrier to approximately 75 miles. Helicopters operate in the inner zone as a result of their limited range and the time required to reach distant operating areas. In addition, helicopters are tasked to remain relatively close to the carrier to assist in ocean rescue attempts should an aircraft mishap occur.

P-3 Orion aircraft cover the outer zone, which is approximately 200 miles and beyond. The P-3 is suited for

this mission as a result of their increased ASW patrol capability and additional flight crew to help perform the mission during extended periods of time.

Although the crew members of an S-3 work as a team to fulfill their mission, the primary player of the S-3 crew, in an ASW mission, is the TACCO. The TACCO uses the talents of the SENSO and the other crew members to "sanitize" a particular area of the ocean. Sonobuoys are selected and deployed in patterns to take advantage of the acoustic conditions in the ocean. These patterns determine the size of the area covered, and the spacing of the buoys within the pattern determine the probability of detecting a submarine.

The TACCO is responsible for informing the SENSO as to the most important buoys in the search and whether they should be tuned omni-directional or directional.

The main phase of an ASW search is called the "search phase." It is often long and tedious and the crew in the back seats of the aircraft prosecute the ASW problem while the crew in the front seats proceed with a surface search. The major concern is to ensure that the aircraft remains within radio range of the buoys so that it receives the information being transmitted from them. This range is line of sight and therefore requires that the aircraft climb to higher altitude as they proceed away from the buoy pattern.

The "localization phase" occurs when contact is believed to exist. At this point the TACCO will attempt to

"triangulate" a position and create an area of probability (AOP). As the search progresses the AOP should be reduced to the point where a rough direction of travel of the contact has been determined.

With the rough direction of travel determined, the TACCO begins to "track" the contact by progressively placing buoy patterns in front of the contact with decreasing spacing between the buoys. This helps reduce possible errors associated with time delays and bearing accuracies.

During the tracking phase the SENSO continues to monitor the buoys and determines what type of submarine is being tracking. This information is transmitted back to the carrier who processes it into their command information center (CIC). The TACCO is in charge overall, but as the problem progresses, the range on the computer screen is reduced. The computer allows the displayed range to go from 1024 nautical miles down to two nautical miles. The COTAC can ease the workload of the TACCO considerably by providing the pilot with information that will place the aircraft where he can be of the most benefit to the TACCO.

The next phase of the search is the "attack phase." When the TACCO determines that the accuracy of the contact's location is within a weapons acquisition range, then the attack phase begins. The flight crew is briefed in attack procedures during pre-flight briefs. Immediately after the weapon is released, the TACCO will release a smoke bomb and

active buoys. Aggressive maneuvering is required at this point to set-up for a reattack. In the event that the computer malfunctions, as a result of this maneuvering, a geographical location exists to begin the search again. The active buoys are deployed to gain contact if the torpedo was not successful in acquiring the intended target. Active rather then passive buoys are used due to the increased level of noise in the water during the attack phase. In addition, active buoys provide real time information in bearing and range. Passive buoys are not as accurate but allow the searching aircraft to remain covert.

B. DEVELOPMENTAL BACKGROUND OF THE S-3

The S-3 Viking was designed and produced by the team of Lockheed and LTV. The team they competed against and ultimately won out over was composed of General Dynamics, Grumman, and IBM. After initial trials and evaluations of the S-3 and its capabilities, it was accepted into the fleet in 1974. The unique aspect of the S-3 production was the fact that the production line was shut down after the initial 187 airframes were produced. All logistical support that was anticipated to be needed was produced in that production run prior to its shut down. A number of spare airframes were stored at Davis Mothan Air Force Base in Tucson, Arizona to replace normal fleet attrition. The problem that soon developed was that the designed mean time between failure did

not take into account a realistic evaluation of the rigors of the fleet environment. The result was a premature failure of components and a reduction in the mission effectiveness of the S-3. Program funding had not anticipated these problems and a serious spare parts deficiency resulted. To alleviate this shortage of parts, the aircraft stored at Davis Mothan AFB were cannibalized to provide the spare parts needed by the fleet.

The factors which contributed to the premature failure of the electronic components of the aircraft were high temperatures and humidity. Aircraft which operated in geographical areas with these conditions experienced the most problems. Complicating this problem was the Navy's push for the "600 Ship Navy." This fleet expansion included aircraft carriers which required more S-3 aircraft than were available.

Then Deputy Chief of Naval Operations Vice Admiral Wesley McDonald was quoted as saying:

> There are only a fixed number of aircraft (S-3) for the 11 current squadrons. Each of the present carriers has ten S-3s on board. When CVN-71 USS Theodore Roosevelt joins the fleet in the late eighties, there will be a need for 12 S-3 squadrons. This will cause an immediate shortage of Vikings. That shortage will continue through the 1990s and will become critical with the introduction of CVN-72 and subsequent carriers. [Ref. 3]

The decision was made however, not to reopen the S-3 production line due to the excessive costs. The anticipated shortage of aircraft was corrected by reducing the number of aircraft per operational squadron.

In 1981, Lockheed received a $14.5 million contract to upgrade two Vikings to the S-3B configuration with improved acoustic processing, expanded electronic support measure coverage, increased radar processing capabilities, a new sonobuoy receiver system and provisions for carrying Harpoon air-to-surface missiles. [Ref. 4]

These improvements to the S-3 were intended to increase their ASW performance within the fleet, increase the maintainability of the aircraft, increase compatibility between ASW platforms within the navy and increase the overall mission effectiveness. The reason for these improvements were as a result of recent advancements within the Soviet submarine force, and an attempt to ease parts availability, in addition to saving substantial sums of money through the use of common components.

C. OPERATIONAL NEED

Until recently, the Soviets have been rapidly developing a full offensive Naval Force. Throughout the 1980's, and, it was anticipated, through the projected S-3A aircraft life, this threat was to consist of: a modern, versatile surface force; high speed quiet nuclear submarines; advanced surface, subsurface, and air-to-air missiles; and sophisticated surveillance and C^3 (command/control/communications) systems. These advances represented a determined Soviet effort to

develop a coordinated, multifaceted attack capability against operating naval forces and sea lines of communication.

These Soviet improvements were considered to be able to lessen the ASW tactical effectiveness of the S-3A weapon system in the 1980+ time period. Furthermore, a sea control force concept change, from CVA/CVS to CV, had evolved since the S-3A design freeze in 1968.

CVA designated carriers were associated with attack missions and CVS carriers were associated with anti-submarine warfare. CV carriers combined these missions.

Constraints on the number and type of aircraft, that were able to be deployed aboard a CV, had resulted in the requirement of embarked aircraft to be as effective as possible. This required that the S-3A become responsive to surface surveillance tasking in a hostile wartime surface-to-air missile (SAM) environment. This need precipitated major improvements. The areas of these improvements were C^3, surface surveillance control (SSC), surface ship attack (ASUW), and antisubmarine warfare (ASW).

D. OPERATIONAL CONCEPT

1. <u>Missions</u>

The improvements the S-3 required at the time of the initial operational requirement were focused on the S-3's ability to perform both offensive and defensive ocean SSC and ASW missions. The emphasis of these improvements was on

projecting an ASW destructive capability in remote or close-in threat areas or sectors. This capability was to be able to be utilized both individually or in coordination with other airborne ASW units, and ship and submarine towed acoustic array systems to protect the task force, merchant shipping, or other high value unit, as the original S-3 had. In addition, the new S-3 was to add the ability to conduct a "real time" response to developing surface threats by providing force threat/attack warning, and/or independent targeting and stand-off attack.

E. CAPABILITIES REQUIRED

1. Performance Goals

The proposed S-3 improvements needed to demonstrate substantial state of the art improvements over the S-3A. These improvements were to provide improved C^3, surface surveillance, and ASW sensor and weapon delivery capability, in addition to the added capability for stand-off attack of surface ships. Major system parameters were subject to trade-off studies to assure a balanced cost-effective design. The goal was to improve the S-3 with a minimum of new hardware development. The performance goals of these systems are as follows.

a. Communication/Command/Control (C^3)

The improved S-3 had as a minimum goal to be compatible with sea control platforms projected for the 1980's

including all CV-associated forces, submerged submarines, and shore-based ASW aircraft and facilities.

b. Surveillance

(1) Electronic Surveillance. The S-3 needed an increased capability to cover a greater range of the electromagnetic spectrum of air and surface threats. Also, improved bearing accuracy, auto-classification capability, and system throughput for the ability to detect and track multiple emitters was also desired.

(2) FLIR (Forward Looking Infrared). Improved resolution, increased elevation capability, and a recording capability for in-flight and post-flight analysis.

(3) Radar. Improved detection range for surface surveillance with a goal of auto-detection and multiple target auto-track.

(4) IFF (Identification Friend or Foe). Mode interrogation capability within design range of the radar.

c. Surface Ship Attack

The S-3, as it was foreseen, needed the capability to employ complementary missile systems which had direct fire, day/night, and long range anti-ship capabilities.

d. Anti-submarine Warfare (ASW)

The improved capabilities to be included in the S-3B were the following.

(1) Advanced Sensor Development Under Decision Coordinating Paper 96. These components were being developed

for use in other naval units to enhance compatibility, maintainability and reduce overall system costs.

(2) Advanced weapons. The ability to employ ASW weapons anticipated to be in the 1980-1990 weapons inventory. These weapons are intended to be upgraded torpedoes and the addition of the Harpoon missile.

(3) Magnetic Anomaly Detection (MAD). Improved MAD capability with automatic compensation. Automatic compensation reduces the possibility of human error and enhances effectiveness. The MAD operates like a giant metal detector.

(4) Sonobuoy Receiving System. The Advanced Sonobuoy Communication Link (ASCL), for compatibility with DCP-96 goals, is intended to increase crew flexibility by providing a larger number of sonobuoy frequencies.

F. QUANTITY AND COST OBJECTIVES

The S-3 improvements were required for retrofit in the 160 S-3 aircraft that existed in the fleet. Additional kits were anticipated to be needed, if additional airframes were procured to replace attrited aircraft.

A preliminary design-to-cost goal for the improvements was projected to be $3.6M/aircraft in FY77 dollars. Relaxation of requirements, particularly in areas where small decreases in capabilities would result in significant cost savings, were directed to be thoroughly investigated.

G. S-3 WEAPON SYSTEM IMPROVEMENT PROGRAM (WSIP)

The above characteristics outlined the operational requirements which initiated the S-3 WSIP. These improvements were intended to improve the S-3A's capability to meet current and projected submarine threats to the CV Battle Group. The program was intended to modify 160 S-3 aircraft with improved acoustic processing, expanded electronic support measure coverage, increased radar processing capabilities, a new sonobuoy receiver system, and a Harpoon missile capability.

On 13 August 1980, a Navy Decision Coordinating Paper (NDCP), NDCP W0489-AS, was approved by the Secretary of the Navy (SECNAV) that authorized conditional Full-scale Engineering Development (FSED) utilizing FY80 funding. This phase completed investigation of subsystem design alternatives, initiated preparation of weapon system design specifications and critical radar hardware development, and also provided for development of specific system/subsystem acquisition strategies including Government Furnished Equipment (GFE)/Contractor Furnished Equipment (CFE) considerations and competitive procurement strategies.

Later, NDCP (Revision 1) recommended approval of a Full-scale Engineering Development (FSED) Program commencing in FY81. This document incorporated the program guidance provided by the assistant SECNAV (ASN, Research and Evaluation) during the 14 November 1980 program review and provided a review of program options related to cost and

mission effectiveness. The Acquisition Review Council approved Milestone II on 24 February 1981 and the Chief of Naval Operations (CNO) directed the Program Objectives Memorandum (POM) research development test and evaluation (RDT&E) funding augmentation, to attain the specified initial operating capability (IOC).

The basic developmental approach for achieving increased performance in the S-3A, incorporated Navy standard systems and GFE. The major components of the WSIP which were approved by the NDCP are the following.

1. Acoustic

- AN/UYS-1(V) Advanced Signal Processor (ASP).
- OL-320/AYS Data processing--Memory Group.
- AN/ARR-78(V)2 Sonobuoy Receiver (Advanced Sonobuoy Communication Link) (ASCL).
- AN/AQH-7 Analog Tape Recorder (ATR).
- AN/ARS-4 Sonobuoy Reference System (SRS).

2. Nonacoustic

- AN/APS-137(V) Inverse Synthetic Aperture Radar (ISAR).
- AN/ALR-76 Electronic Support Measures (ESM).
- AN/ALE-39 Electronic Counter Measures (ECM).
- AN/AYK-10B General Purpose Digital Computer (GPDC) hardware and software.

3. Weapons

- AGM-84D/AWG-19(V) Air to Surface Harpoon.

H. SYSTEM GROWTH

Within the development of the WSIP, provisions were incorporated for future growth of the systems. This was also a requirement of all other ASW programs being developed. This provision allowed technological advances, in either submarine quieting, computer hardware and software to be added after for the benefit of better ASW capacity. These provisions were required as a result of DCP 96, February 1977, which outlined the Navy's effort to consolidate its ASW programs in an attempt to create commonality within its ASW forces.

In FY83, the percentage of Research, Development, Test and Evaluation funds (RDT&E) in the DON budget decreased from 10% to 9%. This prompted one periodical to speculate that "the Navy will utilize high technology for evolutionary increases in the performance of existing fleet aircraft and weapons systems." [Ref. 5]

I. THE WSIP CONTRACTOR

Because of their carrier-based ASW expertise in the development of the original S-3, Lockheed Company of California was selected as the systems integration contractor. Integrated Logistics Support (ILS) considerations were determined to have a high priority throughout the WSIP. This emphasis on ILS reflected the findings of a GAO report that suggested to Congress that the "Navy needs to increase S-3A readiness to ensure effective use of the planned weapon system

improvement." [Ref. 6] In response to this, specific emphasis was concentrated on compatibility of the WSIP improvements with support facilities that would be available at the time of the S-3B initial operating capability (IOC). IOC is defined as delivery of the first operational aircraft to an S-3 squadron.

Other areas given consideration were: adequate logistics and maintenance supportability, and efficient transition of the S-3 aircraft into the S-3B configuration. These areas were stressed, again, to comply with DCP 96, which pointed out the need for a "common element which would be flexible enough to be used in present, and planned ASW platforms--air, surface ship, submarine and shorebased." [Ref. 7]

J. FINANCIAL CONSTRAINTS

In order for the IOC to be realized, the milestones of the program had to be accomplished in an efficient manner. At face value, the WSIP is a modification of an existing airframe. However, the program had to be treated as a major acquisition with closely monitored acquisition milestones and phases which eventually lead up to the IOC.

The S-3 WSIP consists mainly of modification to existing avionics systems and software. These upgrades allow the incorporation of new technology avionics equipment and software developed for other Navy ASW platforms. This procedure provided for increased compatibility of ASW

platforms, a reduced need for research and development funds, and reduced the overall risk of the program. The following milestones highlight the most important aspects of the WSIP program and will provide an insight into the progress toward IOC attainment.

1. Milestone IIA

Milestone IIA included the testing and design validation efforts by the contractor. These focused primarily on hardware qualifications and performance testing on the advanced signal processor (ASP) and sonobuoy receivers. The Harpoon Missile had previously been satisfactorily tested on the S-3A prior to the WSIP. The ECM system was a proven system on another carrier-based aircraft, the A-6 Intruder, and required only small changes to accommodate installation on the S-3. Lockheed Corporation developed the preliminary software program performance specifications, performed system integration analyses and plans, and performed structural weight and power analyses. These tests were performed under controlled conditions within Lockheed Corporation.

2. Milestone IIB

The test and evaluation within Milestone IIB consisted of two parts. They were the Development Test and Evaluation (DT&E) and the Initial Operational Test and Evaluation (IOT&E). The phase within this Milestone was FSED.

a. The Contractor Test

This test consisted of both ground and flight tests with technical surveillance of the contractor's developmental testing and witnessing of the contractor's formal and informal demonstrations. The Government inspectors were Navy functional specialists who had previously reviewed the test plans and procedures, and analyzed test results and contractor actions. These Government inspectors were attached to the Naval Air Test Center (NAVAIRTESTCEN) Patuxent River, Maryland. Their analysis culminated in the first flight of the S-3B occurred on 13 September 1984.

b. Developmental Test (DT-IIA)

This was a preliminary assessment used to determine the hardware readiness for DT-IIB. Developmental tests were conducted by Naval Air Test Center (NAVAIRTESTCEN). This Phase was completed on 19 December 1984.

c. Developmental Test (DT-IIB)

This test was used to access the effectiveness and accuracy of the system to detect and track both acoustic and non-acoustic targets. The results from this test and the results from the operational test (OT-IIA) were used to form the basis for the Approval for Limited Production (ALP), Milestone IIIA. This Phase was completed on 18 January 1985.

d. Operational Test (OT-IIA)

This test focused on the operational effectiveness of the systems, determined operational suitability, and

identified areas of weakness which needed to be reviewed and corrected. This testing was performed by Operational Test and Evaluation (OPTEVFOR) and completed on 22 March 1985. The Production Readiness Review (PRR), issued on 5 February 1985, certified that the program was ready to enter initial production. The OPTEVFOR report indicated that except for software deficiencies, the S-3B had the potential to be operationally effective suitable. These conclusions supported recommendation for limited production.

3. Milestone IIIA

The Department of the Navy Systems Acquisition Review Council (DNSARC) was held on 11 July 1985. This Council authorized the WSIP program to proceed with Milestone IIIA (ALP).

a. Developmental Test (DT-IIC)

This test was performed by NAVAIRTESTCEN Personnel to certify the S-3A WSIP program ready for technical evaluation (TECHEVAL).

b. Developmental Test (DT-IID) TECHEVAL

TECHEVAL is the formal ground and flight testing performed by NAVAIRTESTCEN. This testing is used to determine compliance of system performance to specification requirements and will provide a basis for certification of the system to commence operational evaluation. NAVAIRTESTCEN completed TECHEVAL on 25 April 1986 and recommended the S-3A WSIP for OPEVAL.

c. Operational Test (OT-IIB) OPEVAL

The command which conducted this testing was the Operational Test and Evaluation Force (OPTEVFOR) Patuxent River, Maryland. The squadron within the command that conducted the appropriated ground and flight tests of the WSIP was VX-1. VX-1 is a composite squadron which evaluates the Navy's ASW programs. OPEVAL was suspended on 19 September 1986. The OPEVAL is an operational evaluation of the program under realistic conditions. The suspension was permitted to allow the correction of the software deficiencies identified by OPTEVFOR.

4. Milestone IIIB

A Navy Program Decision Meeting was held on 17 April 1987 which authorized an additional year of limited production.

a. Developmental Test (DT-IIE) TECHEVAL

NAVAIRTESTCEN commenced DT-IIE (TECHEVAL) 13 April 1987 but this was again halted on 28 April 1987 for acoustic deficiencies. The TECHEVAL restarted on 8 September 1987 and was eventually completed on 13 November 1987.

b. Operational Test (OT-IIB) OPEVAL

VX-1 began the second OPEVAL on 8 December 1987 and completed it several months later on 11 April 1988. The first limited production S-3B was rolled out at Naval Air Station Cecil Field, Jacksonville, Florida, on 17 December 1987.

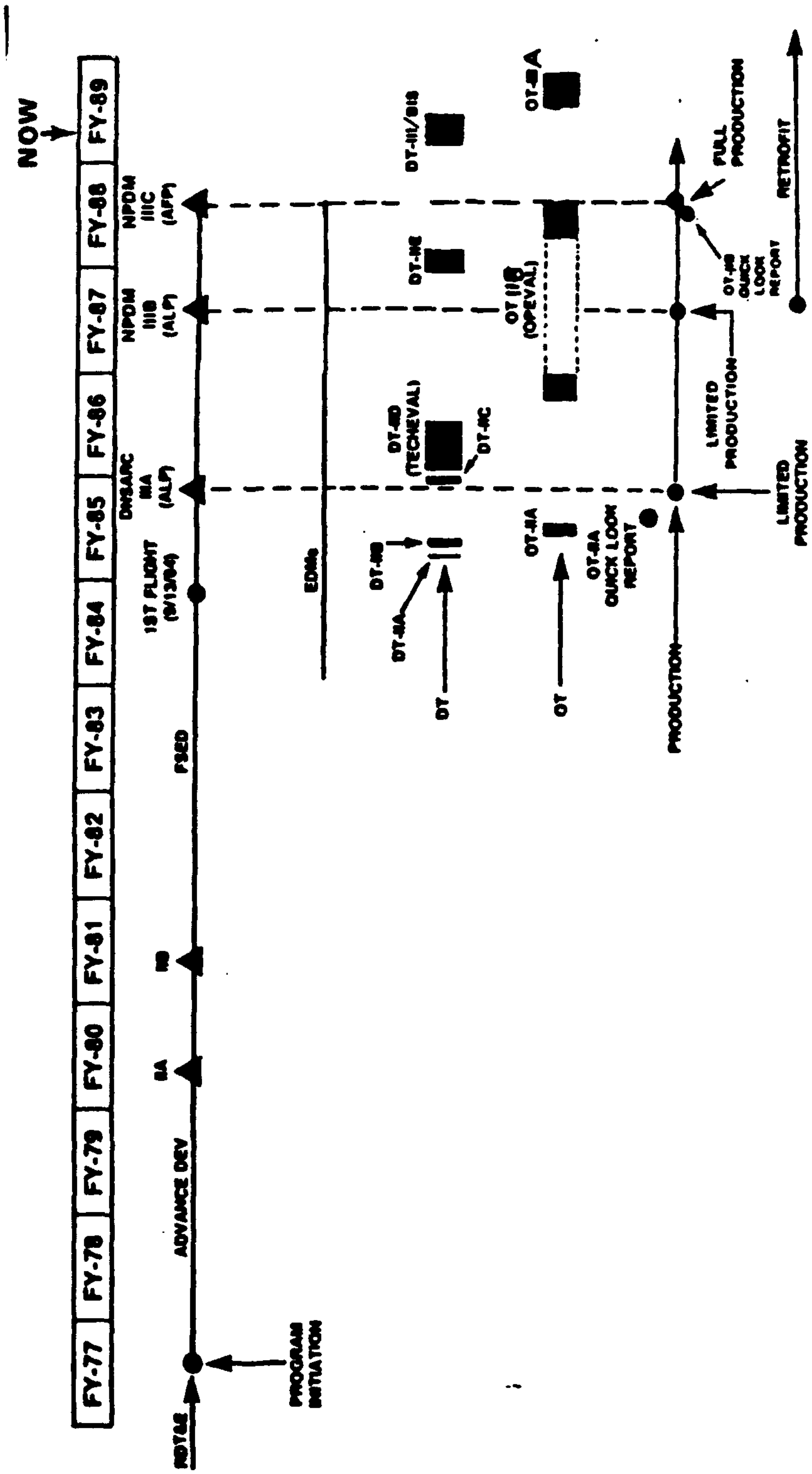
5. Milestone IIIC Approval for Full Scale Production (AFP)

Milestone IIIC approval occurred in May 1988. At this point, converted aircraft had already been rolled out to the East Coast Fleet Replacement Squadron (FRS), (VS-27) at NAS Cecil Field, Jacksonville FL. The initial six aircraft were delivered to VS-27 prior to the initial deliveries to operational fleet squadrons. All East coast squadrons were converted prior to West coast squadrons in order to simplify the conversion process. It was determine in this manor to simplify the conversion process and minimize the period of time both types of airframes would co-exist.

Figure 1 provides a visual reference of the phases and milestones of the S-3 WSIP.

K. SUMMARY

This chapter has outlined the operational environment, history and development of the S-3 WSIP. An example of the cockpit teamwork which is required to complete a successful ASW mission in an S-3 was provided to show the complexity of the S-3 systems. Also outlined was the WSIP which, when incorporated creates an S-3B. The last section of the chapter focused on the acquisition process of the WSIP and the numerous steps that were taken to satisfy the Milestones and phases of a major weapon system program.



Source: NAVAIR PMA-244

Figure 1. S-3 WSIP Program Structure

Figure 1. S-3 WSIP Program Structure
Source; NAVAIR PMA-244.

III. RESEARCH APPROACH

A. INTRODUCTION

Program Managers have a great deal of responsibility for the programs they manage. One aspect of this responsibility is the significant amount of time that is involved in the budget review of their programs. Some sources estimate that "he must devote 30 to 50 percent of his time promoting and defending his/her program" in the battle for competing resources [Ref. 8]. Hence, the program manager's job is surrounded by competitors and the competition is very real. In the DOD/DON world of scarce resources a thorough analysis of the competitive environment may provide useful insight.

B. FRAMEWORK FOR ANALYSIS

Professor Michael E. Porter [Ref. 9] has developed a definition of competition, which though originally intended for the private sector, may also apply to public sector management. He states that:

> In the fight for market share, competition is not manifested only in the other players. Rather, competition in an industry is rooted in its underlying economics, and competitive forces exist that go well beyond the established combatants in a particular industry. Customers, suppliers, potential entrants, and substitute products are all competitors that may be more or less prominent or active depending on the industry.

The model Porter developed in reference to this definition allows some insight into why this is so. His model focuses on

how competition shapes the strategy an organization uses to survive and grow. This competition is based on five basic forces. Collectively, the strength of these forces have a direct impact on the success of an organization in accomplishing its goals/mission.

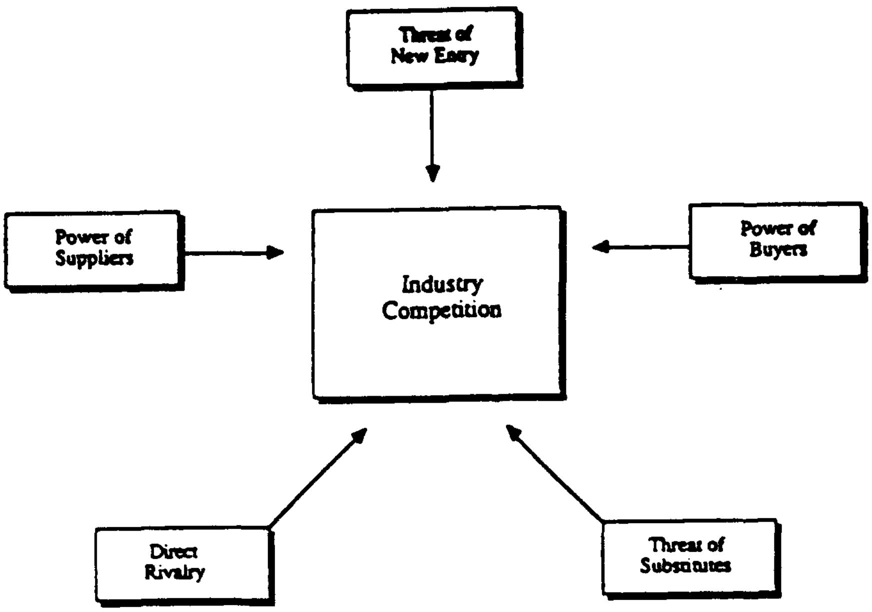
The basic factors within Porter's model focus on the private sector product line manager. A product line manager is an individual who is responsible for managing a specific product line (e.g., steam turbines) or product group (e.g., industrial products). A product line manager has total responsibility for the profitability of a product including research and development and capital budgeting. The product line manager competes against other companies as well as internally against other product line managers for scarce resources.

Within the public sector, such as in the Department of the Navy, the program manager is the product line manager counterpart who is also affected by Porter's factors. This model lends itself to a visual presentation of the environment and its forces within which a program manager has to operate. To the extent the program manager knows of and understands these different competitive pressures, is an indication of his or her ability to develop an effective plan of action. These forces point out strengths and weaknesses of his organization, indicate trends, and identify areas where strategic changes may yield the greatest payoff.

Within the model, Porter identifies five competitive forces:

- Industry Competition; Direct Rivalry.
- Power of Buyers.
- Power of Suppliers.
- Threat of Potential Substitutes of the Product.
- Threat of New Entrants into the Industry.

Each of these competitive forces, to one extent or another, has an impact on the ultimate budget of an individual program office and their related programs. This model, as shown in Figure 2, will be used to organize the analysis of the financial management implications that confront the program manager.



Source: [Ref. 9]

Figure 2. Competitive Strategy Model

1. Industry Competition; Direct Rivalry

Each year the debate over the Federal Budget becomes more intensive. Efforts to reduce the size of the federal deficit have put extreme pressure on all areas of the government to be able to justify its needs or anticipate cuts. Unfortunately, as a larger portion of the federal budget has become overwhelmed by the growth of entitlement spending and the interest payments on the national debt, additional pressure is placed on departments that fall within discretionary spending. It is these funds that Congress looks to for cuts or reprogramming for other programs. Discretionary spending is targeted by Congress because they are able to manipulate these monies in the short run without fear of political repercussions from their constituents. However, this may create serious harm to the long-term program benefits (such as national security) from these short-term political moves.

Competition for funds within the DOD is a fact of doing business. Predominantly, the three service departments compete to at least maintain, if not grow, their respective "piece of the pie." With the advent of negative real growth in the defense budget, beginning in 1985, the inter-service competition intensified. All areas were carefully scrutinized for possible savings. The DON did take cuts but not to the extent of the Army and Air Force as its mission was deemed essential to national security.

During the expansion in defense in the early 1980's the Navy fared equally well. Credit for this success can be contributed to the charismatic leadership of former Secretary of the Navy, John Lehman. His efforts to market a "600 ship Navy" as critical to national defense, created a symbol which every one could visualize and aim for.

The Navy's intra-department rivalries, especially between the five system commands, was where the battle for resources, to a greater extent, was won or lost. Although the WSIP was a small dollar program, the components which made up the S-3B kit were spread between the two largest of the system commands, NAVAIR and Naval Sea Systems Command (NAVSEA) Washington, D.C. Together, they formed alliances to support the purchase of the WSIP components which were common to each other's programs.

If alliances were a factor, the majority of the alliances which would develop would be between the civilian core of the program office. They provide the continuity and stability needed for the system to work. Over the long-run these individuals are involved in a particular program for the longest period of time. The military program managers, although knowledgeable and professionally respected, rotate on a periodic basis (three years) which does not allow for as extensive a network to be created.

2. Power of Buyers

The vast majority of the program managers efforts are involved in the budget review process. The budget review process affects all public sector programs and the WSIP is no exception. Each year the WSIP encountered on average three upper-level budget reviews. Normally these reviews are performed by the Navy Comptroller's Office (NAVCOMPT), the Office of the Secretary of Defense (OSD), Office of Management and Budget (OMB), and finally Congress. Each of these reviews can have a significant impact on an individual program.

Each of these reviews can be viewed as "the Buyers" determining what they are willing to purchase. The NAVCOMPT budget review focuses on the importance of the program to the "Fleet" and the overall "carrier strategy." Although fiscally constrained, this budget review tends to be more operationally oriented. They determine the likelihood of mission success, the ability of the program to deter the enemy and, in the event of a conflict, the ability to win.

On a larger scale the OSD/OMB budget review focuses on the policy implications of the budget. In light of fiscal constraints they determine the potential risk to the National Security if the technology were to be postponed. They also determine what level of exposure would be acceptable to minimize the risk of obsolete technologies.

The Congressional Committee's budget review determines the all-important budget. Congress can be viewed as both a

supplier of funds for all programs and the buyer of the products they finance. As such, the Congressional review within both the authorization and appropriation committees of each house have the tendency to favor defense programs in their districts and may add "pork" to the Defense Budget in the name of National Defense. These are powerful forces within which the program manager has little, if any, influence.

3. <u>Power of the Suppliers</u>

Congress has the ultimate control of providing funds to specific federal agencies, including DOD. Once the DOD receives these funds they distribute them to the individual service departments. It is the service departments who allocate the funds for the approved programs to the private sector contractors.

Contractors are selected predominantly on the extent of their knowledge and the level of experience within the field of production. The level of expertise and knowledge base have direct impacts on the learning curves of the corporation. Longer learning curves lead to increased production costs and a longer period of time to produce the production run. The less experienced the contractor the greater degree of risk that is associated with production. Extensive increases in the time to complete production also tend to increase the possibility of technological

obsolescence. This is the case within "high-tech" systems manufacturing.

Many corporations are involved in mutually exclusive product lines (e.g., LTV Corporation). The size of these different divisions within the corporation may provide an idea of the degree of exposure to the corporation. The level of risk assumed by a particular division may result in corporate instabilities should it fail. If this were to happen, the exposure of the Government to a would be increased if no other supplier is available.

4. <u>Threat of Substitutes</u>

The potential for other technologies to replace or eliminate the need for a particular mission is always present. Within the DOD the Air Force tries to perform the mission of the CVBG, and the Navy submarine force attempts to replace the need for land based ballistic missiles, and the Army tries to refute the need for the Marine Corps.

Challenges to a particular product or company in the private sector can take the form of the new technologies, superior price, improved quality and performance or shorter delivery schedules. These all possess the potential to force replacement of existing products. In DOD, some of these same concepts may be present. An example of which might be the proposed V-22 Osprey and it's potential to replace the S-3. However, the aircraft program has experienced delays due to budget cuts and it may not be fielded until the end of this

century. There still exists a great deal of risk within the program. An additional consideration is the potential cost and quality problems, which have been known to arise in other complex acquisition programs. The price will undoubtedly be higher than the S-3B.

5. Threat of Entry

In line with the potential substitutes of a program, are the threats of new entries into the industry. These new entries can take the form of Soviet technological advances or the application of an existing or new technology within the industry. These advances can make the cost of countering them cost prohibitive, or the use of existing technologies more effective, or cheaper to use. For example, silencing techniques applied to submarines may eventually make carrier based ASW obsolete. Also, attempts have been made to use satellites for target localization.

The main barriers to new entrants into the industry are the high cost, limited capital resources, and Congressional pressure for increased non-defense spending.

Porter's framework will be used in the analysis to discuss the WSIP in areas where it provides insights. This is presented in Chapter IV.

C. DATA COLLECTION

To obtain information for a case analysis of the WSIP several methods were used.

1. Documentation

The primary sources of information that were used were the acquisition plan, the milestone review documentation and programmatic financial data. This information was obtained from the S-3 Program Office, the Cost Analysis Department within NAVAIR associated with the S-3 WSIP and Lockheed's ASW Finance Department.

2. Interviews

The use of interviews provided vital information which assisted in the analysis of the documentation. The information collected assisted in determining how the data had been developed and how the program office used it to brief their program to other organizations. The interviews also allowed the individual to give his/her perspective of the program in a candid way which led to greater supposed in the validity of the data.

Interviews were also used to provide a perspective from the contracting side of the S-3 WSIP. By also speaking with the contractor, new information was provided on how the system works. This new perspective provided an insight into the working relationship that had developed between the program office and the contractor and how information received from the program office, and vice versa, was exchanged.

3. Published Materials

Journals, magazines and other printed materials within the Naval Postgraduate School library were also used. These

types of documentation were utilized to provide insight into the political and operational environment within the legislative and executive branches of the Government and the effects they had within the DOD and DON.

4. Researcher Experience

The researcher's professional experience as a Naval Flight Officer, was used to provide an insight into the demanding operational environment within which the S-3 has had to operate. By understanding how the platform is used in the Carrier Battle Group an understanding of what the WSIP is trying to accomplish can be gained.

5. Sources of Information Not Used

Questionnaires were not used in the research method because of the limited benefit they would provide to the type of research that was being undertaken.

D. SUMMARY

The methods previously mentioned within this chapter were determined to be the most beneficial in accomplishing the required research. Other methods could have been used to obtain additional information. However, limited time and money prevented their use.

IV. ANALYSIS AND DISCUSSION OF THE DATA

A. PRESENTATION OF THE WSIP DATA

The Budget review process has had a dramatic impact on the WSIP. An example of the changes that can result from these reviews can be reflected in the review cycle of 1984. The FYDP at the beginning of the year (FY85) had a total of 160 S-3B kits being purchased over a period of five years. This period of time was from FY85 to FY89. The Program Objectives Memorandum (POM) supported these numbers. However, the NAVCOMPT budget review shifted the load of kit purchases from a normal distribution over the five-year time period to a skewed distribution. This reflects smaller numbers of kits being purchased in the near term and larger numbers purchased at the end of the five-year time period. This obviously decreased funds in the early years in favor of competing programs. The implication is that the S-3 WSIP would receive increased funding in the latter years.

Subsequently, the OSD/OMB budget review decreased the number of kit purchases in FY86 an additional four, and stretched the WSIP program an additional year into FY90. Congress accepted the OMB proposal. Budget reductions were the reason for the stretchout of the program. FY86 was the first year of negative growth in defense spending. This negative growth continued through FY89 and continued to be the

source of pressure which resulted in the WSIP program being stretched well into the 1990's with fewer kit purchases.

By FY89, the defense cuts led the various budget players to stretch the WSIP program by an additional five years, increasing the period of time of the program's estimated completion. Also, the total number of S-3B kits that were scheduled to be produced had been reduced to 144, which was a 10% reduction from the 160 originally planned.

The recent ending of the Cold War with the Soviet Bloc caused new reviews of existing weapon systems. As a result, the President's FY91 Budget shows a reduction in force of S-3 aircraft per squadron, further reduced to a total of 121 S-3B kits that will be purchased. That is an additional 15% reduction. The WSIP program at the present time is scheduled to be completed in FY92.

Table I illustrates the effects of the various budget reviews on the WSIP program's units of production.

1. Budget Effects on the WSIP

The budget review process created two factors that have had the greatest effect on the WSIP program. These factors were the WSIP program stretchout and the reduction in the production quantities. These two factors will be analyzed to determine the extent of their effect on the WSIP.

TABLE I

WSIP PRODUCTION QUANTITIES

FISCAL YEAR	85	86	87	88	89	90	91	92	93	94	95	TOTAL
BASELINE FY80	18	48	48	46								160
JAN 84 (FYDP)	2	39	47	47	25							160
JUN 84 (POM 86)	2	39	47	47	25							160
JUL 84 (NAVCOMPT)	2	30	44	46	38							160
OCT 84 (OSD/OMB)	2	26	44	46	38	4						160
JAN 85 (FYDP)	2	22	36	46	38	4	12					160
JUL 85 (POM 87)	2	22	28	33	28	18	20	9				160
OCT 85 (FYDP)	2	22	21	17	24	33	38	3				160
JAN 86 (FYDP)	2	22	21	13	26	33	38	5				160
JUN 86 (NAVCOMPT)	2	22	21	13	26	33	38	5				160
OCT 86 (FYDP)	2	22	23	15	25	20	17	5	31			160
JAN 87 (FYDP)	2	22	25	8	6	10	12	7	21	47		160
JUL 87 (NAVCOMPT)	2	22	25	24	24	14	24	9				144
OCT 87			NO BUDGET CALL									
JAN 88 (FYDP)	2	22	25	10	24	14	24	9	14			144
JUN 88 (NAVCOMPT)	2	22	25	10	24	10	10	14	14	13		144
OCT 88 (OSD)	2	22	25	10	24	10	10	14	14	13		144
JAN 89 (FYDP)	2	22	25	10	24	10	10	14	14	13		144
JUN 89 (APPORTIONMENT)	2	22	25	10	24	10	9	13	12	13	4	144
SEP 89 (OSD)	2	22	25	10	24	10	9	14	12	13	3	144
JAN 90 (OMB)	2	22	25	10	24	15	15	8				121
JUN 90 (NAVCOMPT)	2	22	25	10	24	15	15	8				121

Source: NAVAIR, PMA-244

a. Program Stretchout

The stretchout of the WSIP program has the potential to increase the total cost of the WSIP program. The

longer time line would force the manufacturer to maintain the production facility for a greater period of time and, as a result, incur additional fixed costs each year beyond the original production cycle. These costs are passed on to the government as part of the contract costs. Also, a greater degree of risk is associated with program extension and a result in product obsolescence. Technological advances within the electronics industry on average become outdated after six years (e.g., computer mainframes). This period has been determined as the product life cycle in the computer industry over the past 30 years.

More importantly, the obsolescence of new hardware and software in strategic weapon systems may jeopardize national security in the event of hostilities. As originally conceived the S-3 WSIP was viewed as essential to CVBG defenses within relatively short time frame of five years, not the eight or ten years as the budget process pushed the program.

b. Program Production Cuts

The WSIP was to consist of a production run of 160 S-3B kits. Over a five-year period, beginning in FY85, the intended annual production was to be two, 39, 47, 47, 25, for each year respectively. The total costs associated with this production run are summarized in Table II.

The total costs of the WSIP program listed in Table II include monies for RDT&E, purchase of the kits

TABLE II

PROPOSED WSIP PRODUCTION COSTS FY84
($ millions)

FISCAL YEAR	83	84	85	86	87	88	89	TOTAL
RDT&E	130.8	57.5	42.1	20.7	8.2			259.3
APN5			74.2	286.7	303.9	210.7	94.3	969.8
APN6			3.7	53.9	72.3	70.6	14.7	215.2
O&M,N			13.9	15.9	18.8	16.1	7.0	71.7
TOTAL COSTS	130.8	57.5	133.9	377.2	403.2	297.4	116.0	1516.0
UNITS			2	39	47	47	25	160

Source: NAVAIR, PMA-244

(APN5), installation of the kits (O&M,N), and purchase of the spare parts (APN6) and funds for the conversion of S-3A trainers (O&M,N).

As the WSIP program was stretched out, the cost structure (e.g., percents of APN5, APN6, O&M,N) of the program began to change. The following Tables III-V, provide "snap shots" of changes across different budgets in the program's total costs from FY87 to date. The decline of the total cost dollars are attributable to the reduced production amount and to the increased use of Government Furnished Equipment. These factors will be discussed in later sections.

Note that these production numbers are the costs of a modification program and should not be confused with the production costs of the airframe. Also, note that the difference between Table III and Table IV is the result of the reduction in the units of production in FY87.

TABLE III

PROPOSED WSIP PRODUCTION COSTS FY87
($ millions)

FISCAL YR	81-6	87	88	89	90	91	92	93	>94	TOTAL
RDT&E	236.0	13.7								249.7
APN5	303.0	135.0	45.0	44.2	59.7	60.1	41.5	115.5	183.9	988.4
APN6	44.8	33.3	6.7	4.2	6.9	7.4	4.0	14.9	29.6	151.8
O&M,N	5.3	3.1	10.7	10.9	6.6	4.4	3.9	5.1	33.4	83.4
TOTAL COSTS	589.6	185.1	62.4	59.3	73.2	71.9	49.4	135.5	246.9	1473.3
UNITS	24	25	8	6	10	12	7	21	47	160

Source: NAVAIR, PMA-244

TABLE IV

PROPOSED WSIP PRODUCTION COSTS FY87
($ millions)

FISCAL YEAR	81-6	87	88	89	90	91	92	>93	TOTAL
RDT&E	236.0	13.7							249.7
APN5	303.5	135.0	56.5	103.2	67.0	128.9	39.4	70.8	904.3
APN6	44.8	34.9	8.2	10.2	14.7	12.1	4.8	12.9	142.6
O&M,N	5.3	3.0	6.9	20.0	9.4	8.3	3.6	14.8	71.3
TOTAL COSTS	589.6	186.6	71.6	133.4	91.1	149.3	47.8	98.5	1367.9
UNITS	24	25	10	24	14	24	9	14	144

Source: NAVAIR, PMA-244

TABLE V

PROPOSED WSIP PRODUCTION COSTS FY90
($ millions)

FISCAL YEAR	81-6	87	88	89	90	91	92	TOTAL
RDT&E 236.0	13.7							249.7
APN5	303.5	135.0	56.5	103.2	57.6	70.8	70.8	797.4
APN6	44.8	34.9	8.2	10.2	8.3	12.7	12.7	131.8
O&M,N	5.3	3.0	6.9	20.0	7.0	14.8	14.8	71.8
TOTAL COSTS	589.6	186.6	71.6	133.4	72.9	98.3	98.3	1250.7
UNITS	24	25	10	24	10	14	14	121

Source: NAVAIR, PMA-244

c. Effects of the Reduction of the Production Base

It was believed that the reduction of the number of S-3B kits purchased by the Navy would have an effect on the unit price of the S-3B kits. As the number of kits was reduced, the associated contractor costs would be spread over fewer kits and, as a result, the unit price of each kit should increase. Also, reducing the number of kits, in effect, increases the learning curve, which also results in a reduction in the economies of scale and hence, increased costs.

To determine to what extent the per unit cost has increased, an accurate determination of "recurring flyaway" costs need to be known. "Recurring flyaway" costs are defined as the percentage of the program's total costs that are incurred to create one S-3B. The other portion of costs not used in this calculation are referred to as "nonrecurring"

costs. This definition of "recurring flyaway" costs then requires that RDT&E, and trainer conversion costs, the "nonrecurring" portion of total costs, be excluded from the calculation. The trainer conversion costs are associated with a portion of the O&M,N funding. The funds which are included in "recurring flyaway" are APN5, APN6, and O&M,N (installation). A standard percentage of these three funding accounts are then used as a basis to determine per unit flyaway costs. This base is then divided by annual production to determine per unit cost. The latest per unit flyaway costs are considered to be procurement sensitive and were not released by the S-3 Program Office. Table VI, however, provides the FY87 per unit cost estimates for the WSIP.

TABLE VI

PER UNIT COST ESTIMATES FY87
($ millions)

FISCAL YEAR	81-6	87	88	89	90	91	92	93	>94	TOTAL
RECURRING FLYAWAY	100.9	81.6	25.3	18.3	36.7	40.3	22.7	72.7	146.7	545.2
UNITS	24	25	8	6	10	12	7	21	47	160
UNIT COST	3.3	3.2	3.1	3.7	3.4	3.2	3.5	3.2		

Source: PMA-244

B. ANALYSIS OF THE WSIP

1. Financial Management Implications

Because Lockheed was selected as the sole source system integrator of the WSIP components, the program office was aware of obvious costs savings which could be obtained by "breaking out" the components of the WSIP to Government Furnished Equipment (GFE). In order to accomplish this a Level III data package is desired. This data package contains the production specifications of the component so that it can be reproduced by a qualified contractor.

When the components are Contractor Furnished Equipment (CFE), Lockheed subcontracts out for these items and adds a marks-up to the price to the Government. The general acquisition trend is to move away from GFE because of the risk the government assumes to provide GFE "on time" to meet the prime contractor's schedule. The WSIP program did incorporate the GFE method. The trend away from GFE with/without the Level III data package results from the program office's adversity to risk. If a component is late the program office is open to a claim from the prime contractor.

The original Full Scale Engineering and Development (FSED) contract was written as a cost plus incentive fee contract (CPIF). A negotiated incentive fee was incorporated into the contract and the incentive that was provided to Lockheed was to control costs. This allowed them to maintain

their fee by controlling costs through prudent program management.

The follow-on contracts which were given to Lockheed on a yearly basis were Firm Fixed Price (FFP). The program office managers used this type of contract after they had satisfied themselves that they had a firm idea of the program's technical requirements so that contractor risks were assumed to be less.

The goal of this acquisition strategy was to retain the prime system integrator for limited production, in order to facilitate the incorporation of needed design changes in production. At this point, in any program, you normally do not want to make major design changes during production.

After the program office had determined the per unit cost structure, FFP contracts were awarded.

2. Shift to Government Furnished Equipment

To save additional production costs, the program office "broke out" several WSIP components to GFE and ultimately saved production costs. The Level III data package for a component can be competed out to any qualified contractor. By increasing the number of contractors who can produce the component, cost savings are likely to be recognized.

Originally, the percentage of these two types of equipment was to be 73% CFE and 27% GFE. Beginning in FY87 this percentage was turned around to 73% GFE and 27% CFE as

the individual components of the S-3B kit were "broken out" and competition between suppliers was possible.

At this point the data packages were to be competed, ultimately using FFP contracts. This type of contract obtains the best price for that particular WSIP component. Table VII provides an outline of the different components which were "broken out" by the WSIP Program Office.

TABLE VII

WSIP COMPONENTS; "BROKEN OUT" TO GFE AND GFE (COMPETITIVELY SELECTED)

"BREAKOUT" TO GFE

Prototype PTC Trainer-Singer Link. FFP contract FY85.

ESM-IBM. FFP contracts FY87 to present.

GPDC-UNISYS. FFP contracts FY87 to present.

ATR-DATA RETRIEVAL SYSTEMS. FFP contract FY87.

SRS-CUBIC. FFP contracts FY87 to present.

RADAR-TEXAS INSTRUMENTS. FFP contracts FY87 to present.

GFE (COMPETITIVELY SELECTED)

ASP-IBM. FFP for FSED. FFP FY85 to present.

SRX-HAZELTINE. FPI for FSED. FFP FY85-86, recompete FY87-89.

ECM-VARIOUS. FFP for FSED. FFP annually recompeted FY85 to present.

Source: PMA-244

An indication of the effects of this action can be determined by reviewing the dollar value of the annual FFP contracts Lockheed received. By going to GFE, the program

office was able to compete kit components for greater savings. Table VIII shows the number of annual contracts written by the program office to Lockheed. The annual decrease in the total dollar amounts of these contracts is apparent as the additional use of GFE became more dominant.

TABLE VIII

WSIP CONTRACTS AWARDED TO LOCKHEED

FISCAL YEAR	84	85	86	87	88	89	90
LOT NUMBER	FSED	1	2	3	4	5	6
TYPE	CPIF	FFP	FFP	FFP	FFP	FFP	FFP
DOLLAR AMOUNT ($M)	210.0	79.3	206.3	35.8	20.0	36.9	3.5

Source: Lockheed Corp

As a result of the increased use of GFE the unit price of a WSIP kit charged by Lockheed decreased over time. Table IX shows the WSIP per unit cost for each year, 1985-1990.

TABLE IX

WSIP PER UNIT COST AS CALCULATED BY LOCKHEED

FISCAL YEAR	85	86	87	88	89	90
LOT NUMBER	1	2	3	4	5	6
UNITS	2	22	25	10	24	10
PER UNIT COST ($M)	29.7	3.9	0.887	0.746	0.685	0.331

Source: Lockheed Corp.

3. <u>Substitutes for the S-3</u>

The capabilities of the S-3 are unmatched by any other carrier-based jet aircraft. No substitutes were considered when the WSIP was originally conceived. Helicopters lacked the speed and range, and patrol aircraft could not be relied upon to be able to assist the CVBG due to their inability to land on an aircraft carrier. The V-22 has been proposed as a possible alternative. However, the program itself is a high risk prospect. As pointed out earlier, the V-22 is a high cost and uncertain program. Its entry into the ASW field would undoubtedly increase these costs.

4. <u>Competition in the WSIP Production</u>

Originally, Lockheed was selected as the sole source producer of the S-3B. Government sources indicated that this selection was expedited to conclude prior to the Competition in Contracting Act (CICA) of 1984 which requires contracts to be competed to obtain the best product at the most reasonable price. This selection was based on the extensive database of knowledge Lockheed had acquired throughout the development of the original S-3A. This precluded the uncertainty and expense of extensive negotiation time and money.

This procedure by the program office was in direct contradiction to the belief that increased competition reduces costs. The capital requirements to induce new entrants into the industry however is not realistic.

In effect, the program office excluded new entrants into the development of the WSIP in an effort to simplify the process.

5. Analysis of the Data

Although the WSIP was affected by the individual factors indicated in Porter's Model, the significant events over the program's life were focused in just two of these factors. As pointed out previously in Chapter III, these were the impacts of Congress (Power of Buyers) through the budget review cycle, and the use of GFE by the program office to control the costs incurred by Lockheed (Industry Competition). The following pages will outline the effects of these events.

a. Budget Review Instabilities

The effects of the budget review cycle created substantial instabilities within the S-3 WSIP. The original stretchout of the program and the subsequent reduction in S-3 WSIP kits, indicates that the program office operates within an extremely volatile fiscal environment. This uncertainty within the system seriously degrades the effectiveness of the program offices's efforts to strategically manage the expenditures of the program. More then anything, the cyclical movements of the amount of budget authority have contributed to this negative impact. This is due to past administrations' downsizing of the defense budget. A review of the production quantities proposed through the program's life would be a

budgeteer's nightmare as the future of the program perpetually changed.

b. Effects of the Stretchout and Reduction of the Production Base

From the data that were released from the program office, the total costs of the WSIP would appear to have decreased in spite of the effects of the budget review process. The researcher was unable to justify these numbers with the limited amount of data that were able to be obtained. In Table X, the total costs of the program were originally anticipated to be approximately $1.5 billion for 160 S-3B kits. Prior to the initial reduction of kit purchases in FY87, the bottom line total cost of the program was shown to have dropped to $1.47 billion or (-3%). This reduction in total cost was created by reducing the amount of RDT&E spent on the WSIP by $9.6 million or (-3.7%), APN5, monies "earmarked" for the purchase of WSIP kits increased $18.6 million or (3%), APN6, the spare parts associated with the modification, were reduced by $63.4 million or (-29.5%), and O&M,N was increased by $11.7 million or (16.3%) for installation of kits. This change in the cost structure implies that a greater percentage of total costs were incurred in labor and overhead of Lockheed in the APN5 and O&M,N funds.

Changes occur throughout the life of a program. However, in this case the reduction in the amount of money slated to be spent on parts was the largest. This fact shows

TABLE X

COMPARISON OF WSIP TOTAL PRODUCTION COSTS
($ millions)

FISCAL YEAR	84	87	87	90
RDT&E	259.3	249.7	249.7	249.7
APN5	969.8	988.4	904.3	797.4
APN6	215.2	151.8	142.6	131.8
O&M,N	71.2	87.4	71.3	71.8
TOTAL COSTS	1516.0	1473.3	1376.9	1250.7
TOTAL UNITS	160	160	144	121

the shortcoming of the original S-3A, which was "cutting corners" in the area of parts support. Lack of parts seriously limited the mission capability of the S-3A. The cuts taken by the WSIP in FY87 were predominantly in APN6. In subsequent years these cuts in parts support were never recovered. This seems to indicate that the S-3B may encounter the same problems as the predecessor S-3A.

On a per unit basis, the "flyaway" cost of an S-3B is a percentage of APN5, APN6, and O&M,N. The exact percentage of each is not available for distribution due to its sensitivity. A rough indication of this percentage of "recurring flyaway" costs floats between 47-53% as contractual requirements change.

Originally, in FY84, the per unit "flyaway" cost of an S-3B was anticipated to average $3.6 million dollars over the five-year life of the program. This amount was listed in the original acquisition plan. In FY87, the cost

was projected to average $3.325 million in spite of the program being extended an additional five years. This amount was found in the Milestone IIIB program review.

At the present time the average flyaway cost, as stated in an interview with the program office's "acting" business financial manager, has been approximately $3.98 million over the life of the WSIP. This amount is greater than the target price of $3.6 million that was used in the 1984 acquisition plan by approximately 10% due to inflationary trends.

Since APN6 is a part of the determination of the flyaway cost of an S-3B, it can be presumed that the per unit cost of each aircraft would be somewhat greater had the cut in APN6 not occurred in FY87.

GFE was another factor which affected the total costs of the program. As indicated in Table IX, as each lot of aircraft progressed, the program office's increased use of GFE reduced the per unit cost of an aircraft kit that Lockheed charged the Navy from $3.9 million down to $.331 million. This is not an indication of substantial reductions in costs but an indication of the program office's efforts to "break out" components to GFE and compete the WSIP components. As more components were competed, additional contractors were awarded the contracts. In a fairly direct relationship, the dollar amount of contracts written to Lockheed have decreased

per unit of output as a result of their reduced contract dollars.

C. RAMIFICATIONS OF THE BUDGET REVIEW ON THE WSIP PRODUCTION

The effects of the budget review cycle on the WSIP program seem to indicate that a great deal of budget control of the program is out of the hands of the program manager. The WSIP program was competing for funds during a time when the CNO was emphasizing the need for advanced ASW systems to counter advancements within the Soviet Navy. However, Congress was more concerned with social programs. A major target for funds for these programs was the defense budget. The result was a period of time where the defense budget experienced negative real growth. The Navy reevaluated their priorities and decided to spread the WSIP program over a larger number of years, and later reduced the number of units to be produced.

Common sense would dictate that savings on paper would be the short-term ramification and, over the long-run, there would ultimately be greater production costs to the Navy. The reduction of the number of kits has resulted in what would appear to be overall cost savings. But this is not the case when viewing the program from per unit "flyaway" costs.

Initially, the program was scheduled to be procured over a period of five years and was to cost $1.5 billion for 160 units. Then the program was reduced to 144 units for $1.37

billion. The latest reduction if accepted, will produce 121 units for $1.25 billion.

The per unit "flyaway" cost was originally estimated at $3.6 million per unit. If the stated $3.98 million average cost per unit is accurate, an additional $55 million in per unit "flyaway" costs will be realized if 144 units are produced. This additional amount is $46 million if 121 units are produced. This calculation is derived by taking the difference of the original per unit cost estimate and the current average per unit cost and multiplying by the production base.

D. SUMMARY

The WSIP has experienced substantial instabilities throughout its existence. These instabilities have ranged from the effects of the defense down sizing to the changes in the acquisition strategy of the program office to become more competitive. Although it has managed to survive these events, it has not gone unchanged. Changes have affected all parts of the program and have predominantly been driven by financial considerations on the short-term political environment.

V. CONCLUSION AND RECOMMENDATIONS

A. FINDINGS

It is apparent that the WSIP of the S-3 aircraft has experienced several dramatic changes throughout the program. The cuts in the defense spending can be identified as the single factor that had the greatest impact on the program's financial and physical results. The change in the political environment on defense spending resulted in two major WSIP changes: 1) the stretchout of the program, and 2) the eventual reduction in the number of WSIP kits produced.

The changes to the program depended somewhat on the ability of the program manager to anticipate the effects of the political environment. Obviously, the program manager cannot influence this environment and thus has little, if any, control. In addition, the program manager has to understand the environment so that he can react to changes to his/her program in such a way that the general consensus believes that the program is needed and that the people who manage it are competent.

The short-term effects of stretching out the WSIP were that the WSIP savings were available in the DON budget for other higher priority programs. Presumably the benefits of these other DOD/DON programs exceeded the benefits of the WSIP. It would seem logical then that prolonging the

completion of the program would result in increased costs over the life of the program. The program office presents its case with information which portrays actual cost savings as the WSIP was lengthened.

The other major WSIP change was the reduction in the units produced. As the production base was reduced, costs would have to be spread over a fewer number of units. This implies that an increase in the per unit cost occurs, but the latest information is procurement sensitive and unable to be released at this time. However, discussions on the matter would lead to the conclusion that per unit costs have risen only marginally. Costs may have increased more dramatically were it not for two program decisions. One was the reduction of the budgeted amount for spare parts. The other was the program office's decision to shift from contractor furnished equipment to government furnished equipment.

Another action by the program office was the use of FFP contracts. This type of contract holds the contractor to a set price. If he incurs additional costs he dips into his own profits for that contract. This contracting method is very attractive to the program manager in certain situations.

The trend of using GFE has been declining within the acquisition community. The attempts which have been made occurred after the complete data package could be obtained from the prime contractors for use in soliciting bids from competing companies. If done correctly, using the data

package to generate additional competition may result in lower costs.

B. RESEARCH AND SUBSIDIARY QUESTIONS

1. How do Program Managers Deal with the Uncertainty in the Budget Environment and within the Budget Process?

This thesis has shown that the budget environment is extremely dynamic. A prudent program manager will recognize these factors and attempt to manage his program in a manner which will allow him to react to these changes. The greater the degree of flexibility, within the organization, the less of an impediment to the goals of the organization the changes will have.

2. If a Budget Submission is Reduced, What are the Short-term and Long-term Ramifications?

Overall the short-term and long-term ramifications affect different programs in different ways. In the short-term cuts may yield savings or allow reprogramming to other programs but the important issue is that it sends a signal to the program manager that his program has been singled out as having a lower priority then competing programs. His efforts should be to adjust his program (fiscally) in the short-term and for the long-term to reestablish the necessity of his program to avoid a precedence from being created that may seriously affect the program in the future. This process can be visualized in Table I, as the WSIP production quantities expanded and contracted over the years.

3. <u>What Trade-offs Between Dollars and Mission were Decided and How did They Impact the Program Completion, Schedule, Per Unit Costs, and Total Costs?</u>

Policy decisions within the Department of Defense and the Department of the Navy had a definite impact on the WSIP. These events caused a stretchout in the completion of the WSIP. The impact on the per unit costs appears to have decreased but it was not able to be accurately determined due to the limited information that was released by the program office. The same office would have the researcher believe that the total program costs have gone down. This is contradictory to the theory of program stretchout.

4. <u>To What Extent is the S-3 Program Office at NAVAIR Able to Control the Progress of the WSIP?</u>

Overall the program office has been able to overcome the adverse affects of the budget process. The S-3B has been introduced to the fleet and the feedback is promising.

5. <u>Are Programs More Sensitive to Budgetary Constraints at Different Points in the Acquisition Process?</u>

In the earlier years of the WSIP the tendency was to reprogram funds to other higher priority programs. It would appear that the WSIP was more sensitive to cuts early on and during production. As the WSIP matured, this tendency was reduced, the closer the program came to completion.

C. RECOMMENDATIONS

This research should provide an opportunity for further investigation into the total costs and per unit costs of the

program. These total cost figures were suspect due to their tendency to drop after the program had been stretched out over a longer period of time. This occurrence goes against the general belief that maintaining a production facility for a longer period of time should result in additional overhead costs. Also, program stretch out usually lessens the economies of scale advantages.

An additional recommendation would be to provide the program manager with a greater degree of stability of his funding. This funding stability will provide for better planning and managing the course of the program. Also, stability provides economies for the contractor that are passed on to the Government.

D. CONCLUSION

The WSIP is a representative example of the environment within which program managers operate. The dynamic nature of this environment provides the program manager with little control over certain events and the effects they have on their programs. An effective program manager will realize these limitations exist and attempt to strategically and flexibly manage the resources available to him as effectively and efficiently as his/her political environment will allow. However, this is sometimes done at the expense of contractor inefficiencies and at more resultant cost to the Government.

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